GRADUATION PROJECT SUMMARY

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In this thesis, an Adaptive Traffic Signal Control System using Reinforcement Learning (RL) in a traffic simulation environment will be explored to find the best way to manage traffic signals at intersections. This research will focus on optimizing the use of traffic signals to reduce the number of vehicles waiting at traffic signals, decrease the length of vehicle queues beyond the traffic signal at each intersection, and improve the overall efficiency of traffic flow.

Today, most traffic lights are operated using fixed-time traffic control systems. These systems are ineffective because they do not dynamically adapt to the changing and stochastic nature of current traffic flows, thereby creating substantial traffic congestion and inefficiently managing traffic flow. In addition, the adaptive approaches to traffic signal control that currently exist do not provide sufficient mechanisms to manage real-time traffic variability or learn optimal traffic control policies in today's complex transportation environments. Therefore, new intelligent and self-adaptable mechanisms need to be developed to meet the demands of the changing traffic environment.

This thesis focuses on the development and evaluation of reinforcement learning models for traffic signal control that are capable of dynamically adjusting traffic light timings in response to real-time traffic conditions. The research will use a traffic simulation to train and test the RL model and collect, analyze important traffic data such as vehicle densities, queue lengths, and waiting times, allowing optimal strategies to be learned by the RL algorithm through interaction with the environment. The study will then identify the optimal control strategies to maximize traffic efficiency.

Experimental results will demonstrate that the trained model performs better than traditional fixed-time control methods in reducing vehicle waiting times and queue lengths, thereby increasing traffic efficiency at the simulated intersection.

The results show that RL is an effective approach for intelligent traffic signal control and offers potential for future research on large-scale, multi-intersection, and real-world intelligent transportation systems.